Fabrication and Assembly of Displacement Amplifying Compliant Mechanism

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Abstract

Flexural mechanisms have become popular due to their unique advantages over the conventional rigid body mechanisms. Due to absence of friction, stiction, and backlash as against conventional mechanism, compliant mechanisms are unprecedented in precision and reduction in wear and tear. However they face limitation in terms of range of possible displacements. Displacement-amplifying compliant mechanisms are used to get enhanced displacement (2-3 times) at the output as compared to the input. Researchers [2] in the past have proposed various designs of Displacement amplifying compliant mechanisms (DaCMs) which are based on structural optimization. However these are fabricated in a monolithic way. In this paper we consider design, analysis, and fabrication of DaCMs in an alternative assembly route instead of monolithic way. Based on evaluation of various monolithic mechanism proposed previously [2], one of the mechanisms giving highest displacement amplification is selected for analysis and fabrication of a equivalent compliant mechanism made of several assembled parts. The mechanism is designed to give displacement amplification in the range of 3 to 4. Overall size being the important criteria is kept within 300mm X 300 mm and height 100mm Copper beryllium strips are used as flexural links and aluminium clamps are used to connect the flexural links together to form the compliant mechanism. The analysis of the proposed mechanism is carried out using ANSYS to make sure the stresses are well within the limits and to determine geometric nonlinearity in the mechanism. Analysis shows that the overall amplification of about 3.5 is obtained though the relationship between input and output displacement is nonlinear and the stresses are well within limits. Successful assembly of mechanism without warping has been carried out. Further characterization of mechanism would be carried out in the near future.

Keywords: Compliant mechanism, flexural mechanism, displacement amplifying compliant/flexural mechanism.

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